Drop Everything!

Looking up at the drop tower

Could you conduct a scientific experiment in 2.2 seconds? It's an all-or-nothing venture, and scientists at the Microgravity Research Facility at NASA's Glenn Research Center do it all the time. These speedy experiments take place in the 2.2-second Drop Tower.

A drop tower is exactly what it sounds like. This one is a 29.5-meter- (79-feet-) tall chamber where a 453-kilogram (1,000-pound) payload is released and falls at a rate of 80.5 kilometers (50 miles) per hour into a cushioning air bag. Since 1959, about 20,000 drops have been made from this tower. NASA has other towers as well; there's a 5.5 second tower at Glenn, and several more at other NASA facilities.

The big question, though, is, why? Why is it important to drop things down a specially designed chute? Researchers do this to simulate the conditions of microgravity on the Space Shuttle or International Space Station (ISS). There are very few ways to achieve microgravity on Earth; besides the drop towers, microgravity research takes place in underwater neutral buoyancy simulators and in the sky in the KC-135 astronaut training aircraft that is able to achieve about 20 seconds of near-weightlessness as it soars and dips. Each environment for microgravity on Earth has its limitations, however. Experimenting with a flame wouldn't be possible underwater, and watching humans float almost weightlessly wouldn't be practical in the drop tower. Each resource fits a particular set of requirements.

The drop towers work on the same principles as the sensations you feel when a roller coaster crests a hill, when an elevator drops to reach its destination, or when a playground swings to its farthest point back in an arc. It's called free fall.

Microgravity http://nasaexplores.com/lessons/01-044/index.html is a complicated subject. Years ago, the phenomenon was called zero gravity, but now we know that gravity isn't completely gone in space, but is drastically reduced. The prefix "micro" means "one millionth." Astronauts on ISS aren't experiencing true zero gravity; if that were the case, the Space Station wouldn't stay in orbit; it would be on its

way to the farthest reaches of the galaxy. Gravitational forces are greatly reduced, however, and that creates new challenges and even new opportunities for those who work in that environment. Experimenting with microgravity-like conditions on Earth helps everyone take better advantage of time spent in microgravity in space. That's where the drop towers come in.

The experiments in the drop tower are put in a vial or a container, and then built onto a frame for dropping. A cable is attached to the frame, and when the cable is released, the experiment falls down the shaft for 2.2 seconds of near-weightlessness.

The drop tower isn't really in microgravity, however, so engineers have to make a few compensations. As the experiment being dropped falls down the tower shaft, it reaches speeds of 80.5 kmph (50 mph). Anyone who's put his or her arm out a car window going at that speed knows that there's strong aerodynamic drag pulling the arm backwards. That same drag occurs in the drop tower.

To protect the experiment from the aerodynamic drag, it is put inside a drag shield: a rectangle box with a round bottom. Gravity pulls equally on the drag shield and the experiment package. Because of the outer shield, the experiment doesn't feel the aerodynamic drag as it falls, so it falls more freely—as though it is in microgravity.

Some experiments run in as little as 500 milliseconds. That equals 0.5 seconds. To record video information, digital cameras capture data at a rate of 1,000 frames per second. For experiments running this fast, the crucial information may be captured in as few as 14 frames.

What kinds of experiments are done in a drop tower? Some are highly complex, but there are just as many ask basic questions about life in space. How does a candle flame behave in microgravity? Does an hourglass work in low gravity? Will hot air rise without gravity? How does water move when it spills in space? A trip down the drop tower helps provide the answers.

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